THEME: PROTOTYPE OF EXPERT SYSTEM FOR ANALYSIS OF CREDIT RISK AND EVALUATION OF CREDIT CAPABILITY OF DEBTOR

ABSTRACT

Expert systems, i.e. their use in banking technology, produce new way of organization and behavior of the bank as a system. Namely, through substitution of some working places by use of expert systems, number of workers is being reduced, as well as their factor of subjectivity. Objective models becomes dominant and possibility of mistake is being seriously reduced. Research work at the field of development of expert system is based on the most contemporary scientific and technological knowledge and it has big importance for development of banking activity.

As the main function of a bank is approval of credits and as every credit has in itself some risk, important part of credit politics represents evaluation of credit capability of debtor, and by that mean also evaluation of the level of credit risk. Basically, level of risk accepted by a bank is resultant of its preferences to the profitability and liquidity. To achieve a valid evaluation of credit risk and credit capability of debtor in short-term crediting of economy in this original example of expert system, it was used a combination of two well known methods of analysis of credit risk and credit capability:

- Preliminary analysis of credit risk, so called "5C" method, and
- Z-Score analysis.

The work is realized and presented on the base of scientific methodological evaluation of credit capability of debtor and implementation of the evaluation in the expert system through shell VPEXPERT.

KEY-WORDS: banking, software, expert systems.
1. CONCEPT OF ANALYSIS OF CREDIT RISK

General capability of a bank to bear a risk of operation is called solvency or adequacy of capital. In the developed economies solvency is a measurement of capability of a bank to ensure paying back of loaned financial means in long term, i.e. to ensure payment of its creditor at the moment of liquidation. Measurement of solvency of a bank in fact credit capability of the bank or its acceptability for depositors and creditors and adequacy of capital in regard to risk of loss.

As the main function of a bank is approval of credits and as every credit has in itself some risk, important part of credit politics represents evaluation of credit capability of debtor, and by that mean also evaluation of the level of credit risk. Basically, level of risk accepted by a bank is resultant of its preferentions to the profitability and liquidity.

To achieve a valid evaluation of credit risk and credit capability of debtor in short-term crediting of economy in this original example of expert system, it was used a combination of two well known methods of analysis of credit risk and credit capability:

- Preliminary analysis of credit risk, so called "5C" method, and
- Z-Score analysis.

Analysis of credit capability of debtor represents a foundation on which should be based and from which should be drawn evaluation of debtor's credit capability. It includes debtor's occurrence connected with the past and the present, as well as future conditions of business milieu of debtor, proportional with the period of crediting. American business banking analysis with this analysis five factors of debtor's credit capability and calls them "5Cs of credit" or shortly "5C", where the first three factors are favored. These factor are:

- Character
- Capacity
- Capital
- Collateral
- Conditions.

Character of debtor in contemporary context understands properties of debtor or loan applicant connected with its business reputation, belonging to business group and legal status. The character is being divided in four elements:

- Responsibility (properties of managers and owners of company)
- Integrity (own and other business experiences with the debtor)
- Accuracy (accuracy in fulfillment of obligations)
- Consistency (Stand of business books).

In our analysis each of above mentioned elements is being valued in three degrees (excellent, good, bad).

Capacity of debtor represents its capability to pay back approved credit. It is based on the following elements:

- Liquidity of debtor,
- Operational efficiency of the company,
- Rentability of debtor,
- Debt of debtor.

Liquidity of debtor, in case of short-term crediting, understands the base criteria in evaluation of credit capability of debtor. Liquidity is defined as debtor's ability to discharge its obligations properly. Basic indicators of liquidity are the rate of current assets and the rate of financial assets.

\[
\text{Rate of current assets} = \frac{\text{Current assets}}{\text{Current obligations}}
\]

\[
\text{Rate of financial assets} = \frac{\text{Current assets - stock}}{\text{Current obligations}}
\]

In dependence on values of the coefficients of liquidity debtor may have excellent, good or bad liquidity.

Operational efficiency of the company is evaluated from average turnover of debtor, with supposition that the debtor with higher coefficient of turnover forms bigger pay-back potential and it has lower need for additional financial resources. It means
that the bank in eventual credit relations with the debtor has lower risk. Indicators of operational efficiency are given in the following relations:

\[
\text{Average turn over of stock reserves} = \frac{\text{Annual realization}}{(\text{Coefficient stock turnover})} \quad \frac{\text{Average volume of reserves}}{\text{Annual realization}} = \frac{\text{Average business demands}}{(\text{Conversion of demands into cash})}
\]

In dependence on values of coefficient debtor has excellent, good or bad mark for the operational efficiency of the company.

Rentability of the company is especially important indicator for long-term crediting, but it has its role also in short-term crediting. This indicator measures rentability of debtor in order to direct credit resources to the most successful companies. The rentability is being expressed by the rate of nto profit. Nto profit is calculated by reducing of total income with expenses and taxes:

\[
\text{Rate of nto profit} = \frac{\text{nto profit}}{\text{realization}}
\]

In dependence on value of rate of nto profit the mark for the rentability can be excellent, good or bad.

Debt of the debtor is quantitative indicator of credit risk of the bank. It is being expressed by rate of debt:

\[
\text{Rate of debt} = \frac{\text{Debts}}{\text{Assets}}
\]

In dependence on value of rate debt system treats the debt of the debtor as good or bad.

Capital of debtor is defined as permanently invested means of founder and stockholders. This is in fact financial value of purchaser, i.e. its company and it is being measured as net value of the owner's property. It can be calculated when total financial means (assets) is reduced by total obligations (liabilities). Here into account should be taken that bookkeeping value does not reflect market value. Debtor's property is the highest limit of the credit and assurance for pay-back of the credit. In our example it can have two values: yes or no.

Collateral of debtor represents providing of the credit and covers bad points in credit capability of debtor's company. Collateral is related to any means (in assets) available to the debtor as specific guaranty for the credit pay-back. In our example collateral is taken by the expert system as an incoming parameter of analysis with values yes or no.

Conditions or economical conditions of managing are, at the first line, related to conjuncture at the debtor's market. In the example the most important are projections in the period of pay-back of credit. Those projections give values of satisfactory or unsatisfactory conjuncture to the expert system.

Z-Score analysis is specific method of measurement of debtor's financial difficulties and, at the same time, the risk of the bank. Substance of the analysis is in anticipation of reality of debtor's financial position based on use of precise indicators, where these indicators do not replace but supplement previously mentioned indicators. Z-Score analysis is based on example of American middle large companies and it overcomes a gap between coefficient of conventional credit analysis and exact parameters taken on the base of statistical multivariance method of analysis of debtors bonity. Z-indicator of credit quality is calculated from the following relation: (110)

\[
Z=1,2x_1+1,4x_2+3,3x_3+0,6x_4+1,0x_5, \quad \text{where:}
\]

\[
x_1= \frac{\text{current assets}}{\text{total assets}} \quad x_2= \frac{\text{nto profit}}{\text{total assets}} \quad x_3= \frac{\text{bto profit}}{\text{total assets}} \quad x_4= \frac{\text{market value of capital}}{\text{bookkeeping value of total obligations}} \quad x_5= \frac{\text{realization}}{\text{total assets}}.
\]

Critical values of Z indicator are:
Z > 2.98 high performances of debtor business
1.81 < Z < 2.99 minimal debtor's performances
Z < 1.82 debtor's bankruptcy.

Based on the values of Z indicator expert system produces marks excellent, good or bad. This indicator has eliminating character in evaluation of debtor's credit capability.

2. REALIZATION OF PROTOTYPE OF EXPERT SYSTEM FOR EVALUATION OF DEBTOR'S CREDIT CAPABILITY

2.1. Shell VPEXPERT

VPEXPERT is software package - shell for development of expert systems. It was developed in 1984 by Paperback Software International. During further development some modifications have been made. The package has communications with a number of programs for business processing.

VPEXPERT functions on PC and it is relatively simple for use. Besides other possibilities it has also possibility of self-education. Because of that it is classified in group of simple applications of artificial intelligence. It is quick and strong tool for the development of expert system and it uses rules which are very similar to English language.

It enables preparation of individual expert systems and quick preparation of prototypes which can be further expanded to the bigger systems. It also has possibility of communication (acceptance and sending of data) with databases (dBASE and VP-Info), with spreadsheet programs (Lotus and VP-Planner), ASCII files and some executive programs. VPEXPERT, as every other shell, contains two parts:

- base of knowledge (collection of information and data connected with rule of type IF - THEN) and
- mechanism of concluding (program which executes rules and operates with data, and finally makes conclusions)

VPEXPERT can be combined with external data, so that base of knowledge can be modified (enlarged) without modification of the expert system itself.

Communication with the user is very comfortable, user can choose suggested answer, he can give his own answer, he can determine percentage of reliability of the answer, and that everything in a very accessible mode of communication.

Although the shell has its own text editor, expert system in VPEXPERT can be created with any text editor or text processor. The file should only has name with extension .KBS.

2.2. Branch of decision in graphic form
2.3. Branch of decision in text form

Testing kredit.kbs
(= yes CNF 0 )
  (= KREDIT CNF 100 )
  (= (4000000 CNF 100) Testing B1)
  (= IMOVINA CNF 100 )
  (= (113064000 CNF 100) Testing B2)
  (= TAKT CNF 100 )
  (= (46889000 CNF 100) Testing B3)
  (= TOBA CNF 100 )
  (= (3710000 CNF 100) Testing B4)
  (= TZAL CNF 100 )
  (= (1195000 CNF 100) Testing B5)
  (= GR CNF 100 )
  (= (6105000 CNF 100) Testing B6)
  (= POZ CNF 100 )
  (= (9060000 CNF 100) Testing B7)
  (= PPP CNF 100 )
  (= 6000000 CNF 100 )
  (= GPRI CNF 100 )
  (= (6865000 CNF 100) Testing B8)
  (= GTRO CNF 100 )
  (= (4817000 CNF 100) Testing B9)
  (= GPOR CNF 100 )
  (= (103000 CNF 100) Testing B10)
  (= TDUG CNF 100 )
  (= (3734000 CNF 100) Testing B11)
  (= UAKT CNF 100 )
  (= (48282000 CNF 100) Testing B12)
  (= TVKAP CNF 100 )
  (= (113064000 CNF 100) Testing B13)
  (= KVUOB CNF 100 )
  (= 3734000 CNF 100 )
  (= ((TAKT-TZAL)/TOBA) CNF 100 )
  (= (TAKT/TOBA) CNF 100 )
  (= (GR/POZ) CNF 100 )
  (= (GR/PPP) CNF 100 )
  (= ((GPRI-GTRO-GPOR)/GR) CNF 100 )
  (= (TDUG/TAKT) CNF 100 )
  (= (GPRI-GTRO-GPOR) CNF 100 )
  (= (GPRI+GTRP+GPOR) CNF 100 )
  (= (1.2*(TAKT/UAKT)+1.4*(NETO/UAK T)+3.3*(BRUTO/UAKT)+0.6*(TVKAP /KVUOB)+1.0*(GR/UAKT)) CNF 100 )
  (= ODGOVOR )
  (= Testing A0 )
  (= KARAKTER )
  (= Testing B0 )
  (= ODG_INT )
  (= Testing B29 )
  (= KAR_ODG )
2.4. Original text of prototype of expert system KREDIT.KBS

! KREDIT.KBS
ENDOFF;

! Block of Actions
ACTIONS
CLS

! Block for recording of variables and defining necessary relations
FIND KREDIT
FIND IMOVINA
FIND TAKT
FIND TOBA
FIND TZAL
FIND GR
FIND POZ
FIND PPP
FIND GPRI
FIND GTRO
FIND GPOR
FIND TDUG
FIND UAKT
FIND TVKAP
FIND KVUOB

SFA=((TAKT-TZAL)/TOBA)
STA=(TAKT/TOBA)
KOZ=(GR/POZ)
KPG=(GR/PPP)
REN=((GPRI-GTRO-GPOR)/GR)
ZAD=(TDUG/TAKT)
NETO=(GPRI-GTRO-GPOR)
BRUTO=(GPRI+GTRP-GPOR)

Z=(1.2*(TAKT/UAKT)+1.4*(NETO/UAKT)+3.3*(BRUTO/UAKT)+0.6*(TVKAP/KVUOB)+1.0*(GR/UAKT))

! Action which starts mechanism of deciding
FIND ODGOVOR

! Display of results of deciding
DISPLAY "Debtor {ODGOVOR} credit capable!"
;

! Block of rules
! A rules - Final part of deciding incorporates 5 base criterions
RULE A0
IF KARAKTER=Excellent AND KAPACITET=YES AND KAPITAL=Not_sufficient
AND KOLATERAL=YES
THEN ODGOVOR=it is;

RULE A2
IF KARAKTER=Excellent AND KAPACITET=YES AND KAPITAL=Not_sufficient
AND KOLATERAL=NO AND KONJUKTURA=Favorable
THEN ODGOVOR=it is;

RULE A3
IF KARAKTER=Excellent AND KAPACITET=YES AND KAPITAL=Not_sufficient
AND KOLATERAL=NO AND KONJUKTURA=Bad
THEN ODGOVOR=it isn't;

RULE A4
IF KARAKTER=Excellent AND KAPACITET=NO AND KAPITAL=Sufficient AND KOLATERAL=YES
THEN ODGOVOR=it is;

RULE A5
IF KARAKTER=Excellent AND KAPACITET=NO AND KAPITAL=Sufficient AND KOLATERAL=NO AND KONJUKTURA=Favorable
THEN ODGOVOR=it is;

RULE A6
IF KARAKTER=Excellent AND KAPACITET=NO AND KAPITAL=Sufficient AND KOLATERAL=NO AND KONJUKTURA=Bad
THEN ODGOVOR=it isn't;

RULE A7
IF KARAKTER=Excellent AND KAPACITET=NO AND KAPITAL=Not_sufficient
AND KOLATERAL=YES AND KONJUKTURA=Favorable
THEN ODGOVOR=it is;

RULE A8
IF KARAKTER=Excellent AND KAPACITET=NO AND KAPITAL=Not_sufficient
AND KOLATERAL=YES AND KONJUKTURA=Bad
THEN ODGOVOR=it isn't;

RULE A9
IF KARAKTER=Excellent AND KAPACITET=NO AND KAPITAL=Not_sufficient
AND KOLATERAL=NO
THEN ODGOVOR=it isn't;

RULE A10
IF KARAKTER=Good AND KAPACITET=YES AND KAPITAL=Sufficient
THEN ODGOVOR=it is;

RULE A11
IF KARAKTER=Good AND KAPACITET=YES AND KAPITAL=Not_sufficient
AND KOLATERAL=YES AND KONJUKTURA=Favorable
THEN ODGOVOR=it is;

RULE A12
IF KARAKTER=Good AND KAPACITET=YES AND KAPITAL=Not_sufficient
AND KOLATERAL=NO AND KONJUKTURA=Favorable
THEN ODGOVOR=it is;

RULE A13
IF KARAKTER=Good AND KAPACITET=YES AND KAPITAL=Not_sufficient
AND KOLATERAL=NO AND KONJUKTURA=Bad
THEN ODGOVOR=it isn't;

RULE A14
IF KARAKTER=Good AND KAPACITET=NO AND KAPITAL=Sufficient AND KOLATERAL=YES
THEN ODGOVOR=it is;

RULE A15
IF KARAKTER=Good AND KAPACITET=NO AND KAPITAL=Sufficient AND KOLATERAL=NO AND KONJUKTURA=Favorable
THEN ODGOVOR=it is;

RULE A16
IF KARAKTER=Good AND KAPACITET=NO AND KAPITAL=Not_sufficient AND KOLATERAL=NO AND KONJUKTURA=Bad
THEN ODGOVOR=it isn't;

RULE A17
IF KARAKTER=Good AND KAPACITET=NO AND KAPITAL=Not_sufficient AND KOLATERAL=YES
THEN ODGOVOR=it isn't;

RULE A18
IF KARAKTER=Good AND KAPACITET=NO AND KAPITAL=Not_sufficient
AND KOLATERAL=NO AND KONJUKTURA=Favorable
THEN ODGOVOR=it is;

RULE A19
IF KARAKTER=Good AND KAPACITET=NO AND KAPITAL=Not_sufficient
AND KOLATERAL=NO
THEN ODGOVOR=it isn't;

RULE A20
IF KARAKTER=Bad AND KAPACITET=YES AND KAPITAL=Sufficient AND KOLATERAL=YES
THEN ODGOVOR=it is;

RULE A21
IF KARAKTER=Bad AND KAPACITET=YES AND KAPITAL=Sufficient AND KOLATERAL=NO AND KONJUKTURA=Favorable
THEN ODGOVOR=it is;

RULE A22
IF KARAKTER=Bad AND KAPACITET=YES AND KAPITAL=Sufficient AND KOLATERAL=NO AND KONJUKTURA=Bad THEN ODGOVOR=it isn't;
RULE A23
IF KARAKTER=Bad AND KAPACITET=YES AND KAPITAL=Not_sufficient THEN ODGOVOR=it isn't;
RULE A24

! B rules - Checking of debtor's character
RULE B0
IF ODG_INT=yes AND KAR_TAC=Excellent AND KAR_DOS<>Bad THEN KARAKTER=Excellent;
RULE B1
IF ODG_INT=yes AND KAR_TAC=Excellent AND KAR_DOS=Bad THEN KARAKTER=Good;
RULE B2
IF ODG_INT=yes AND KAR_TAC=Good AND KAR_DOS<>Bad THEN KARAKTER=Excellent;
RULE B3
IF ODG_INT=yes AND KAR_TAC=Good AND KAR_DOS=Bad THEN KARAKTER=Good;
RULE B4
IF ODG_INT=yes AND KAR_TAC=Bad THEN KARAKTER=Good;
RULE B5
IF KAR_ODG=Excellent AND KAR_INT=Good AND KAR_TAC=Excellent AND KAR_DOS<>Bad THEN KARAKTER=Excellent;
RULE B6
IF KAR_ODG=Excellent AND KAR_INT=Good THEN KARAKTER=Good;
RULE B7
IF KAR_ODG=Excellent AND KAR_INT=Good AND KAR_TAC=Good AND KAR_DOS=Excellent THEN KARAKTER=Excellent;
RULE B8
IF KAR_ODG=Excellent AND KAR_INT=Good AND KAR_TAC=Good AND KAR_DOS<>Excellent THEN KARAKTER=Good;
RULE B9
IF KAR_ODG=Excellent AND KAR_INT=Good AND KAR_TAC=Bad THEN KARAKTER=Good;
RULE B10
IF KAR_ODG=Excellent AND KAR_INT=Bad AND KAR_TAC<>Bad THEN KARAKTER=Good;
RULE B11
IF KAR_ODG=Excellent AND KAR_INT=Bad AND KAR_TAC=Bad THEN KARAKTER=Good;
RULE B12
IF KAR_ODG=Good AND KAR_INT=Excellent AND KAR_TAC=Excellent THEN KARAKTER=Excellent;
RULE B13
IF KAR_ODG=Good AND KAR_INT=Excellent AND KAR_TAC=Good THEN KARAKTER=Good;
RULE B14
IF KAR_ODG=Good AND KAR_INT=Excellent AND KAR_TAC=Bad THEN KARAKTER=Good;
RULE B15
IF KAR_ODG=Good AND KAR_INT=Good AND KAR_TAC=Good
RULE B16
IF KAR_ODG=Good AND KAR_INT=Good AND KAR_TAC=Good
THEN KARAKTER=Good;

RULE B17
IF KAR_ODG=Good AND KAR_INT=Good AND KAR_TAC=Bad AND KAR_DOS<>Bad
THEN KARAKTER=Good;

RULE B18
IF KAR_ODG=Good AND KAR_INT=Bad AND KAR_TAC=Excellent
THEN KARAKTER=Good;

RULE B19
IF KAR_ODG=Good AND KAR_INT=Bad AND KAR_TAC=Good AND KAR_DOS<>Bad
THEN KARAKTER=Good;

RULE B20
IF KAR_ODG=Good AND KAR_INT=Bad AND KAR_TAC=Good AND KAR_DOS=Bad
THEN KARAKTER=Bad;

RULE B21
IF KAR_ODG=Good AND KAR_INT=Bad AND KAR_TAC=Good AND KAR_DOS<>Bad
THEN KARAKTER=Good;

RULE B22
IF KAR_ODG=Good AND KAR_INT=Bad AND KAR_TAC=Bad
THEN KARAKTER=Bad;

RULE B23
IF KAR_ODG=Bad AND KAR_INT=Excellent AND KAR_TAC<>Bad
THEN KARAKTER=Good;

RULE B24
IF KAR_ODG=Bad AND KAR_INT=Excellent AND KAR_TAC<>Bad
THEN KARAKTER=Bad;

RULE B25
IF KAR_ODG=Bad AND KAR_INT=Excellent AND KAR_TAC=Bad AND KAR_DOS<>Bad
THEN KARAKTER=Good;

RULE B26
IF KAR_ODG=Bad AND KAR_INT=Excellent AND KAR_TAC=Bad AND KAR_DOS=Bad
THEN KARAKTER=Bad;

RULE B27
IF KAR_ODG=Bad AND KAR_INT=Good AND KAR_TAC=Bad
THEN KARAKTER=Bad;

RULE B28
IF KAR_ODG=Bad AND KAR_INT=Bad
THEN KARAKTER=Bad;

RULE B29
IF KAR_ODG=Excellent AND KAR_INT=Excellent
THEN ODG_INT=yes;

! C rules - Checking of debtor's capacity
RULE C0
IF KPC_LIK=Excellent AND KPC_OEP=Excellent AND KPC_REN <> Bad
THEN KAPACITET=YES;

RULE C1
IF KPC_LIK=Excellent AND KPC_OEP=Excellent AND KPC_REN=Bad AND ZAD_ZSC=yes
THEN KAPACITET=YES;

RULE C2
IF KPC_LIK=Excellent AND KPC_OEP=Excellent AND KPC_REN=Bad AND KPC_ZAD=Good AND KPC_ZSC=Good
THEN KAPACITET=YES;

RULE C3
IF KPC_LIK=Excellent AND KPC_OEP=Excellent AND
THEN KAPACITET=YES;
RULE C4
IF KPC_LIK=Excellent AND KPC_OEP=Excellent AND KPC_REN=Bad AND KPC_ZAD=Bad AND KPC_ZSC=Excellent THEN KAPACITET=YES;

RULE C5
IF KPC_LIK=Excellent AND KPC_OEP=Excellent AND KPC_REN=Bad AND KPC_ZAD=Bad AND KPC_ZSC=Good THEN KAPACITET=NO;

RULE C6
IF KPC_LIK=Excellent AND KPC_OEP=Excellent AND KPC_REN=Bad AND KPC_ZAD=Bad AND KPC_ZSC=Bad THEN KAPACITET=NO;

RULE C7
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Excellent AND KPC_ZAD=Good AND KPC_ZSC=Good THEN KAPACITET=YES;

RULE C8
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Good AND KPC_ZAD=Good AND KPC_ZSC=Good THEN KAPACITET=YES;

RULE C9
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Good AND KPC_ZAD=Good AND KPC_ZSC=Good THEN KAPACITET=YES;

RULE C10
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Good AND KPC_ZAD=Good AND KPC_ZSC=Bad THEN KAPACITET=NO;

RULE C11
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Good AND KPC_ZAD=Bad AND KPC_ZSC=Excellent THEN KAPACITET=YES;

RULE C12
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Good AND KPC_ZAD=Bad AND KPC_ZSC=Good THEN KAPACITET=NO;

RULE C13
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Good AND KPC_ZAD=Bad AND KPC_ZSC=Excellent THEN KAPACITET=YES;

RULE C14
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Good AND KPC_ZAD=Bad AND KPC_ZSC=Good THEN KAPACITET=NO;

RULE C15
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Good AND KPC_ZAD=Bad AND KPC_ZSC=Bad THEN KAPACITET=NO;

RULE C16
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Good AND KPC_ZAD=Bad AND KPC_ZSC=Exe

RULE C17
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Good AND KPC_ZAD=Bad AND KPC_ZSC=Bad THEN KAPACITET=NO;

RULE C18
IF KPC_LIK=Excellent AND KPC_OEP=Good AND KPC_REN=Good AND KPC_ZAD=Bad AND KPC_ZSC=Bad THEN KAPACITET=NO;
KPC_ZSC=Excellent THEN KAPACITET=YES;
RULE C19
IF KPC_LIK=Excellent AND KPC_OEP=Bad AND KPC_REN=Excellent AND KPC_ZAD=Bad AND KPC_ZSC=Good THEN KAPACITET=NO;
RULE C20
IF KPC_LIK=Excellent AND KPC_OEP=Bad AND KPC_REN=Excellent AND KPC_ZAD=Bad AND KPC_ZSC=Bad THEN KAPACITET=NO;
RULE C21
IF KPC_LIK=Excellent AND KPC_OEP=Bad AND KPC_REN<>Excellent THEN KAPACITET=NO;
RULE C22
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Excellent THEN KAPACITET=YES;
RULE C23
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND ZAD_ZSC=yes THEN KAPACITET=YES;
RULE C24
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Good AND KPC_ZSC=Good THEN KAPACITET=YES;
RULE C25
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Good AND KPC_ZSC=Bad THEN KAPACITET=NO;
RULE C26
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Bad AND KPC_ZSC<>Excellent THEN KAPACITET=YES;
RULE C27
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Bad AND KPC_ZSC<>Excellent THEN KAPACITET=NO;
RULE C28
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Bad AND THEN KAPACITET=NO;
RULE C29
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Bad AND THEN KAPACITET=NO;
RULE C30
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Good AND KPC_ZSC<>Bad THEN KAPACITET=YES;
RULE C31
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Bad THEN KAPACITET=NO;
RULE C32
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Good AND KPC_ZSC<>Excellent THEN KAPACITET=YES;
RULE C33
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Bad THEN KAPACITET=NO;
RULE C34
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Bad AND THEN KAPACITET=NO;
RULE C35
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Bad AND THEN KAPACITET=NO;
RULE C36
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Bad AND THEN KAPACITET=NO;
RULE C37
IF KPC_LIK=Good AND KPC_OEP=Excellent AND KPC_REN=Good AND KPC_ZAD=Bad AND THEN KAPACITET=NO;
RULE C38
IF           KPC_LIK=Good AND
            KPC_OEP=Good AND
            KPC_REN=Good AND
            KPC_ZAD=Good AND
            KPC_ZSC=Bad
THEN    KAPACITET=NO;
RULE C39
IF           KPC_LIK=Good AND
            KPC_OEP=Good AND
            KPC_REN=Good AND
            KPC_ZAD=Bad
THEN    KAPACITET=NO;
RULE C40
IF           KPC_LIK=Good AND
            KPC_OEP=Good AND
            KPC_REN=Bad
THEN    KAPACITET=NO;
RULE C41
IF           KPC_LIK=Good AND
            KPC_OEP=Bad
THEN    KAPACITET=NO;
RULE C42
IF           KPC_LIK=Bad
THEN    KAPACITET=NO;
RULE C43
IF           KPC_ZAD=Good AND
            KPC_ZSC=Excellent
THEN    ZAD_ZSC=yes;

! D rules - checking of debtor's
liquidity in frame of checking of
capacity
RULE D1
IF         SFA >= (1.0)
THEN   KPC_LIK=Excellent;
RULE D2
IF         SFA < (1.0) AND
            STA > (1.0)
THEN   KPC_LIK=Good;
RULE D3
IF         STA <= (1.0)
THEN   KPC_LIK=Bad;

! E rules - Checking of debtor's
  efficiency in frame of checking of
capacity
RULE E1
IF           KOZ >= (0.75) AND
            KPG < (1.0)
THEN    KPC_OEP=Good;
RULE E2
IF           KOZ < (0.75) AND
            KOZ > (0.5) AND
            KPG > (1.0)
THEN    KPC_OEP=Good;
RULE E3
IF           KOZ < (0.75) AND
            KPG < (1.0)
THEN    KPC_OEP=Bad;
RULE E4
IF           KOZ <= (0.5)
THEN    KPC_OEP=Bad;
RULE E5

! F rules - Checking of debtor's
  rentability in frame of checking of
capacity
RULE F1
IF          KOZ >= (0.75) AND
            KPG >= (1.0)
THEN    KPC_OEP=Excellent;
RULE F2
IF          KOZ >= (0.75) AND
            KPG < (1.0)
THEN    KPC_OEP=Good;
RULE F3
IF          KOZ < (0.75) AND
            KOZ > (0.5) AND
            KPG > (1.0)
THEN    KPC_OEP=Good;
RULE F4
IF          KOZ < (0.75) AND
            KPG < (1.0)
THEN    KPC_OEP=Bad;
RULE F5
IF
            KOZ <= (0.5)
THEN    KPC_OEP=Bad;

! G rules - Checking of debtor's
debt in frame of checking of
capacity
RULE G1
IF           ZAD <= (0.25)
THEN    KPC_ZAD=Good;
RULE G2
IF           ZAD > (0.25)
THEN    KPC_ZAD=Bad;
RULE G3

! H rules - checking of Z-score
  in frame of checking of capacity
RULE H1
IF           Z >= (2.99)
THEN    KPC_ZSC=Excellent;
RULE H2
IF           Z >= (1.81) AND
            Z < (2.99)
THEN    KPC_ZSC=Good;
RULE H3
IF $Z < 1.81$
THEN $KPC_{ZSC}=Bad$;

! I rules - Checking of debtor's capital
RULE I1
IF $IMOVINA >= (KREDIT)$
THEN $KAPITAL=Sufficient$;

RULE I2
IF $IMOVINA < (KREDIT)$
THEN $KAPITAL=Not\_sufficient$;

! Block of statements
! Defining of questions for recording of variables and possible values of variables
ASK KOLATERAL: "Is there any collateral ?";
CHOICES KOLATERAL: YES, NO;
ASK KONJUKTURA: "What is conjuncture ?";
CHOICES KONJUKTURA: Favorable, Bad;
ASK KAR\_ODG: "Evaluation of top manager - owner of company ?";
CHOICES KAR\_ODG: Excellent, Good, Bad;
ASK KAR\_INT: "Business experience with debtor ?";
CHOICES KAR\_INT: Excellent, Good, Bad;
ASK KAR\_TAC: "Fulfilling of obligations at time ?";

ASK TAKT: "What is current assets ?";
ASK TOBA: "What are current obligations ?";
ASK TZAL: "What is current stock ?";
ASK GR: "What is annual realization ?";
ASK POZ: "What is average volume of stock ?";
ASK PPP: "What are average demands ?";
ASK GPRI: "What is annual input ?";
ASK GTRO: "What are annual costs ?";
ASK GPOR: "What is taxes ?";
ASK TDUG: "What are current debts ?";
ASK UAKT: "What is total assets ?";
ASK TVKAP: "What is market value of capital ?";
ASK KVUOB: "What is bookkeeping value of total obligations ?";
ASK KREDIT: "How big loan do you need ?";
ASK IMOVINA: "What is ntv value of total capital ?";
2.5. Appearance of screen for recording of variables:

48282000
What is market value of capital?
113064000
What is bookkeeping value of total obligations?
3734000
Evaluation of top manager - owner of company?
Excellent  **Good**  Bad

<table>
<thead>
<tr>
<th>Finding ODG_INT</th>
<th>STA = (TAKT/TOBA) CNF 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing B29</td>
<td>KOZ = (GR/POZ) CNF 100</td>
</tr>
<tr>
<td>RULE B29 IF</td>
<td>KPG = (GR/PPP) CNF 100</td>
</tr>
<tr>
<td>KAR_ODG = Excellent AND KAR_INT = Excellent</td>
<td>REN = ((GPRI-GTRO-GPOR)/GR CNF 100</td>
</tr>
<tr>
<td>THEN</td>
<td>ZAD = (TDUG/TAKT) CNF 100</td>
</tr>
<tr>
<td>ODG_INT = yes CNF 100</td>
<td>NETO = (GPRI-GTRO-GPOR) CNF 100</td>
</tr>
<tr>
<td>Finding KAR_ODG</td>
<td>BRUTO = (GPRI+GTRP+GPOR) CNF 100</td>
</tr>
<tr>
<td></td>
<td>Z = (1.2*(TAKT/UAKT)+1.4) CNF 100</td>
</tr>
</tbody>
</table>

Enter to select  END to complete  /Q to Quit  ? for Unknown

Excellent  **Good**  Bad
Business experiences with debtor ?
Excellent  **Good**  Bad
Fulfilling of obligations at time?
Excellent  **Good**  Bad
**Debtor is credit capable!**

<table>
<thead>
<tr>
<th>THEN</th>
<th>KPC_REN = Excellent CNF 100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KAR_TAC = Good CNF 100</td>
</tr>
<tr>
<td></td>
<td>KARAKTER = Good CNF 100</td>
</tr>
<tr>
<td></td>
<td>KPC_LIK = Excellent CNF 100</td>
</tr>
<tr>
<td></td>
<td>KPC_OEP = Excellent CNF 100</td>
</tr>
<tr>
<td></td>
<td>KPC_REN = Excellent CNF 100</td>
</tr>
<tr>
<td></td>
<td>KAPACITET = YES CNF 100</td>
</tr>
<tr>
<td></td>
<td>KAPITAL = Sufficient CNF 100</td>
</tr>
<tr>
<td></td>
<td>ODGOVOR = it is CNF 100</td>
</tr>
</tbody>
</table>

1Help  2Go  3WhatIf  4Variable  5Rule  6Set  7Edit  8Quit
1Help 2How? 3Why? 4Slow 5Fast 6Quit
Help     2Go       3WhatIf   4Variable 5Rule     6Set      7Edit     8Quit

Help 2How? 3Why? 4Slow 5Fast 6Quit

KAPACITET = NO AND
KAPITAL = Not_sufficient AND
KOLATERAL = YES AND
KONJUKTURA = Favorable
THEN
ODGOVOR = it is CNF 100
Finding KOLATERAL
Finding KONJUKTURA

KAR_TAC = Bad CNF 100
KAR_DOS = Bad CNF 100
KARAKTER = Good CNF 100
KPC_LIK = Good CNF 100
KPC_OEP = Bad CNF 100
KAPACITET = NO CNF 100
KAPITAL = Not_sufficient CNF 100
KOLATERAL = YES CNF 100
KONJUKTURA = Favorable CNF 100
ODGOVOR = it is CNF 100

Debtor is credit capable!

Excellent Good Bad

Is there any collateral?
YES NO

What is conjuncture?
Favorable Bad

Debtor is credit capable!

Excellent Good Bad

Fulfilling of obligations at time?
Excellent Good Bad

State of bookkeeping?
Excellent Good Bad

Is there any collateral?
YES NO

KAPACITET = YES CNF 100
Finding KAPITAL
Testing I1
RULE I1 IF
IMOVINA >= KREDIT
THEN
KAPITAL = Sufficient CNF 100
Finding KOLATERAL

KAR_TAC = Bad CNF 100
KAR_DOS = Bad CNF 100
KARAKTER = Bad CNF 100
KPC_LIK = Good CNF 100
KPC_OEP = Excellent CNF 100
KPC_REN = Bad CNF 100
KAPACITET = YES CNF 100
KAPITAL = Sufficient CNF 100
KONJUKTURA = Favorable CNF 100

Enter to select END to complete /Q to Quit ? for Unknown